EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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Memorandum

To : The EEC

From : A. Manz, E. Dahl-Jensen, G. Hansl and A.J. Herz

Subject : Proposal to measure yields of low-momentum particles emitted near 0° from targets in the extracted proton beam at the PS.

1. INTRODUCTION AND SUMMARY

The existing data on the production of various types of particles in targets bombarded by high-energy (> 10 GeV/c) protons do not extend to secondary momenta below 1 GeV/c [1-3]. In the vicinity of 1 GeV/c, the yields are either still increasing with decreasing secondary momentum or close to the maximum [see, for example, the summary plots given by Ranft[4]], so that one may expect yields to be high also at momenta appreciably below 1 GeV/c. Apart from its intrinsic interest, information on the production of low-momentum secondaries is of use in designing beams of slow particles, and in the planning of experiments. We hope to be able to provide data that have not been available up to now.

We propose to use the existing a_2 beam during periods in which slow ejection 58 is operating to measure the yields of pions, kaons, and protons in the momentum interval 200 MeV/c to 1500 MeV/c. In order to separate these particles, we shall add a DISC counter borrowed from the MSS Group to the existing counter system used in the tuning and monitoring of the beam.

We suggest that the proposed experiment can be scheduled as parasitic user of the e_2 beam (SE58) during the run of experiment S38b in August 1967. Details are given below; we believe that this utilization of protons which would otherwise go to waste will not interfere with other experiments.

The proposal for a much more comprehensive study by Agoritsas et al.[5] came to our notice some time after we had decided to submit a formal proposal for this work. We feel that our limited investigation

which can be done without major expenditure, would be supplementary to that of Agoritsas et al. and should be done in any case.

2. DETAILS

2.1 Quantities to be measured

The quantities obtained experimentally will be the number of particles of a given type emitted, per proton incident on the target, in the forward direction (0°) into the solid angle of acceptance of the system. Measurements with two types of targets are planned. "Thin" disc targets, 4 mm thick and of a diameter sufficient to cover the entire proton beam will be used to obtain information which can be related relatively easily to the elementary cross-sections and to the measured beam intensity. Long targets, as used in practice for beams, will be investigated to provide data applicable directly to beam design. If all these measurements are successful they will provide an experimental check of theoretical calculations of target efficiencies like those recently published by Ranft[6].

2.2 Targets

The a_9 beam has a ten-position revolving target head which can be used for nine different targets and one blank position for background measurements. In the first place we intend to investigate yields in copper targets of several different dimensions, including a thin disc; if sufficient time is available, measurements might also be made on other materials.

2.3 The a_9 beam used as a spectrometer

The layout of the experiment is shown in Fig. 1.

In order to avoid difficulties in the interpretation of the results, the quadrupole lenses of the a_9 beam are not used, and it is operated as a simple spectrometer with two bending magnets.

The acceptance of the spectrometer in the horizontal plane depends on the slit settings which must be optimized to match the acceptance of the DISC counter. A typical case is shown in Fig. 2;

it gives a momentum bite of ± 0.6% and a horizontal angular acceptance of ± 4 mrad. As the bending magnets focus in the vertical plane, the vertical angle of acceptance is defined by a collimator. The total solid angle of acceptance will be of the order of 5×10^{-5} sr.

2.4 Detectors

As shown in Fig. 2, we intend to use a quadruple scintillation telescope followed by a DISC counter. The DISC counter will allow discrimination between pions, kaons, and protons, and below 500 MeV/c it will separate pions from muons. Above 500 MeV/c, the muon contamination will have to be computed, but this does not entail any risk as the calculations can be checked against experiment at 500 MeV/c and below.

2.5 Equipment requirements

With the exception of the electronics for the DISC counter, and of some of the liquids needed as filling for it, essentially all the equipment is already in existance as part of the Λ^0 magnetic moment experiment, the a_9 beam or, in the case of the DISC counter, it can be borrowed from the MSS Group. Most of it is installed and has been tested.

3. SUGGESTED SCHEDULE

At the time of writing (5 May 1967) the latest schedule shows that slow ejection 58 will be operating for experiment S38b (bremsstrahlung) during weeks 32-34.

During the first (new) PS week of that period, the slow ejection will be operating for 1 burst in 5, the remaining 4 bursts going to the m_6 beam in the fast-slow ejection mode. It seems, therefore, that e_{2n}/a_9 can be operated parasitically with one burst in five during that week.

It is planned that during the second week of the period, m_6 shall receive part of every burst (fast ejection) and that the rest

shall be ejected slowly for S38b. This programme excludes e_{2n}/a_9. We therefore request to be scheduled as standby for that week, to run if and when the 200-cm HBC is down for an appreciable time.

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REFERENCES

1) D. Dekkers et al., Phys. Rev. 137, B962 (1965).

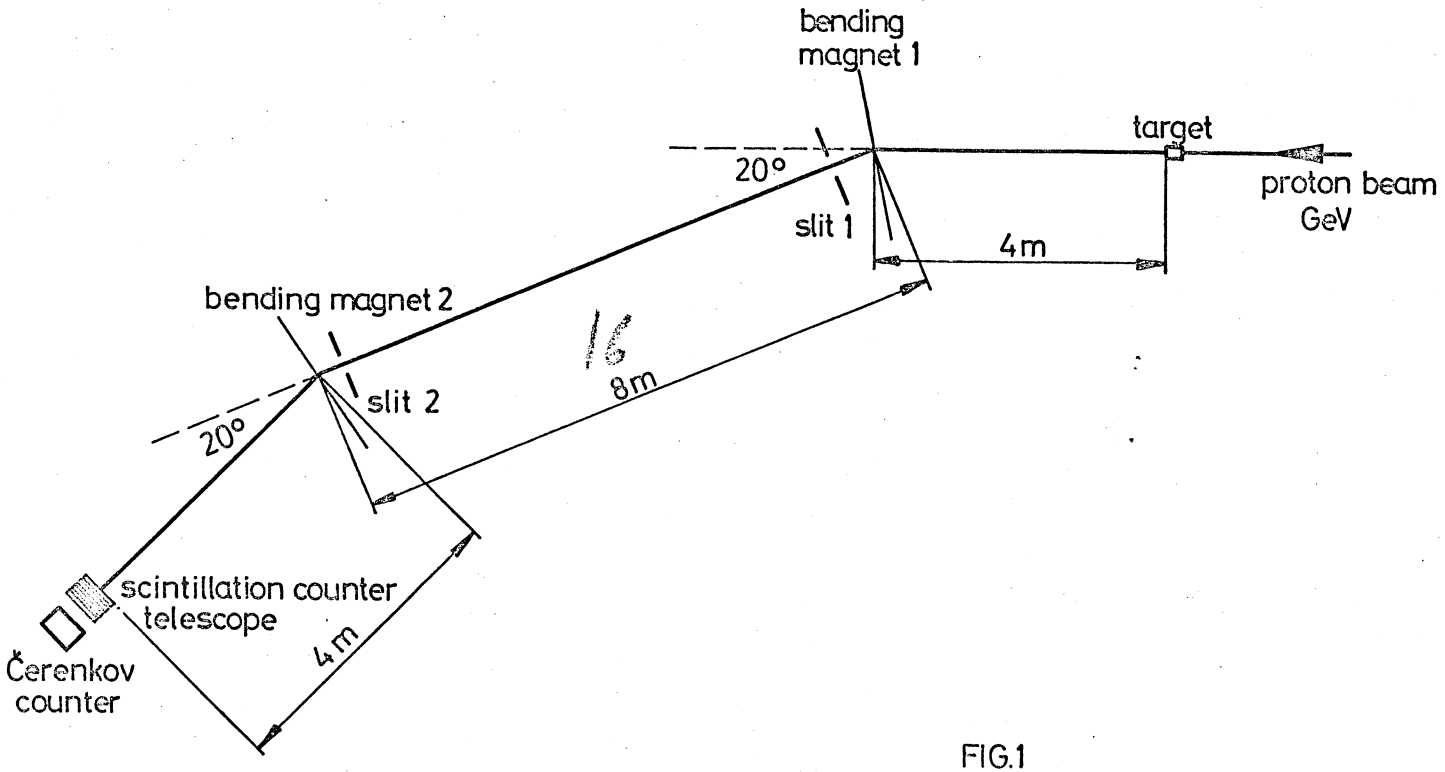
2) R.A. Lundy et al., Phys. Rev. Letters 14, 504 (1965).

3) W.F. Baker et al., Phys. Rev. Letters 7, 101 (1961).

4) J. Ranft, MPS/Int. MU/EP 66-4 (19.2.1966).

5) V. Agoritsas et al., Proposal to EEC entitled "Proposal for an investigation of the low-energy part of secondary particle production spectra at 19 GeV/c incident proton momentum".

6) J. Ranft, MPS/Int. MU/EP 66-10 (10.11.1966).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Čerenkov
counter
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FIG.1

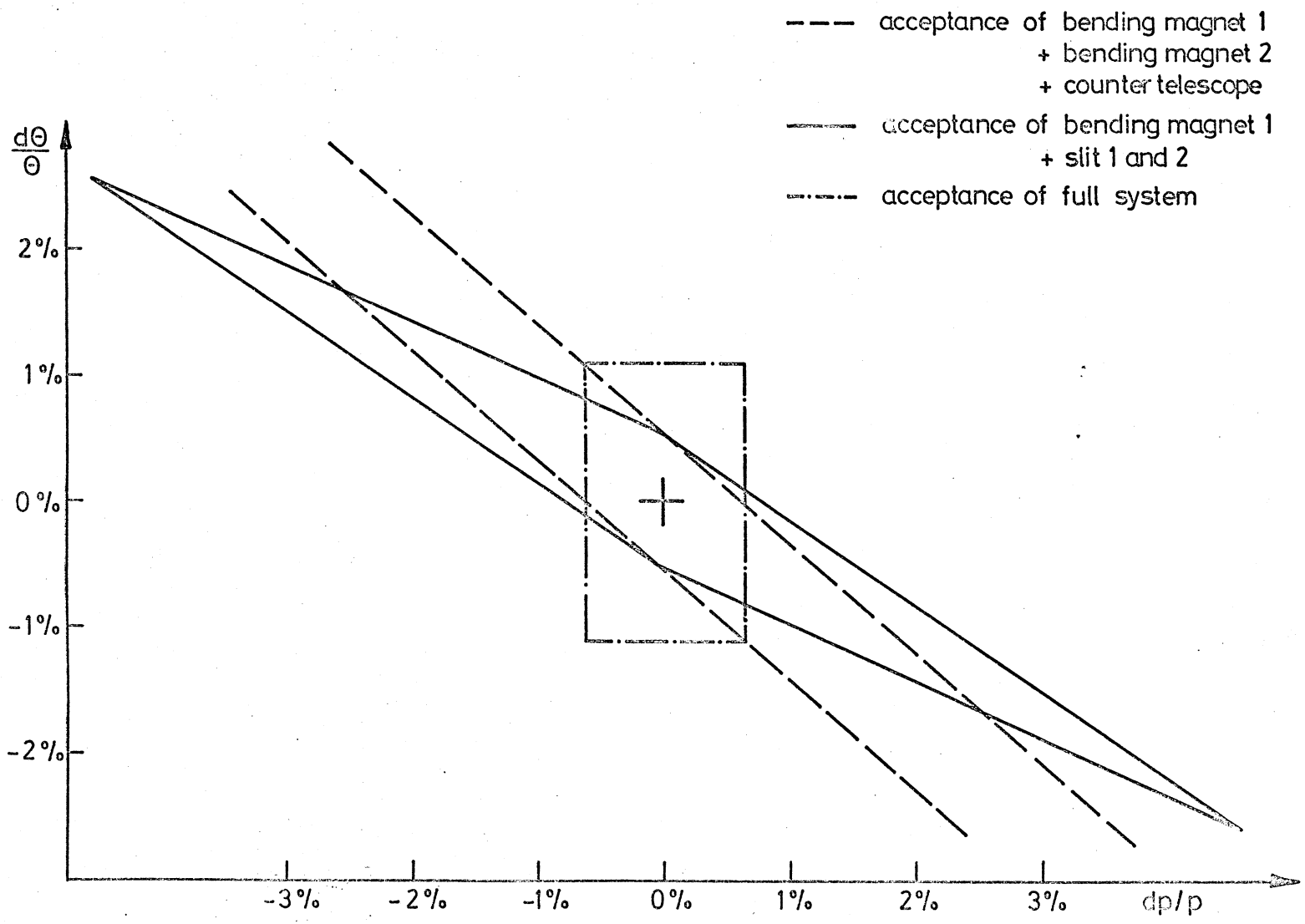
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FIG. 2